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(54) Combined check and pressure-relief valve

(57) A combined check and pressure-relief valve comprises a sleeve 24 slidable in a housing 17 to cover or uncover ports (23, fig. 2). The sleeve is spring biassed to cover the ports, but can be pressed down by an actuator member 34 to uncover them. The valve is mounted in a filter assembly, flow normally passing through an inlet 12, a filter 15, the sleeve 24, and an outlet 13. If flow reverses, the actuator member 34 moves to shut off one end of the sleeve, thus preventing reverse flow through the filter. Excess pressure in either direction will depress the sleeve, exposing the ports and allowing flow between the inlet and outlet, bypassing the filter. The actuator member can be guided by means of a stem 35 sliding in a guide member 37, which snap fits onto the housing 17.

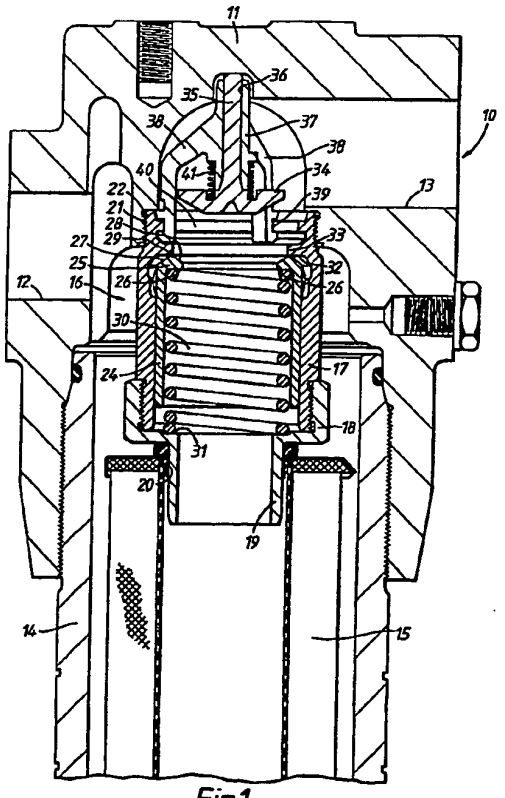

Fig.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

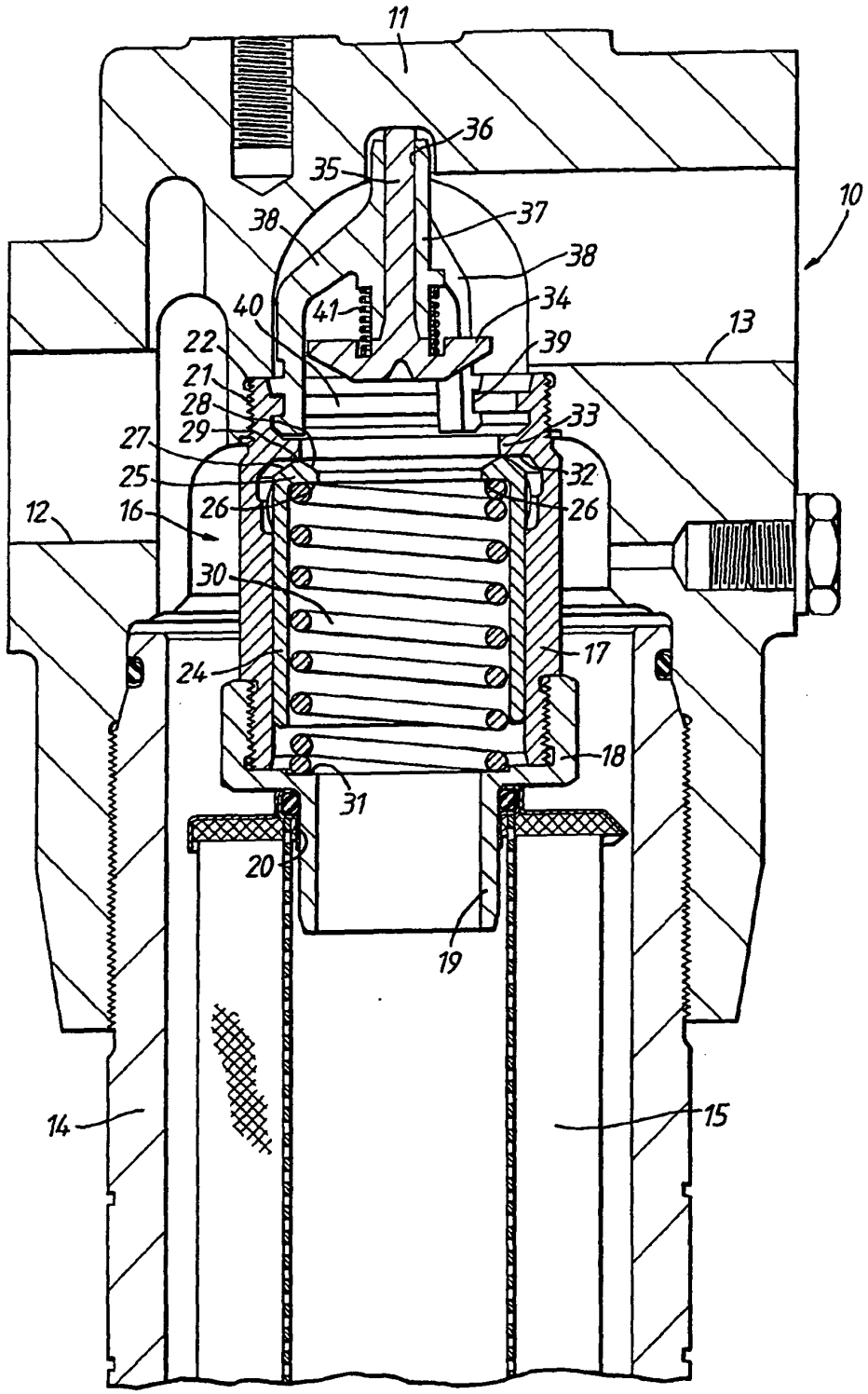
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Fig.1

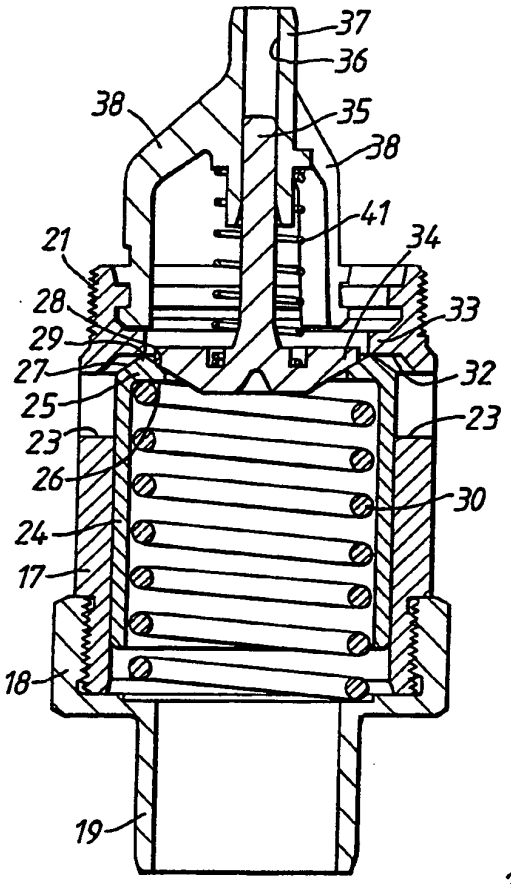
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Fig.2

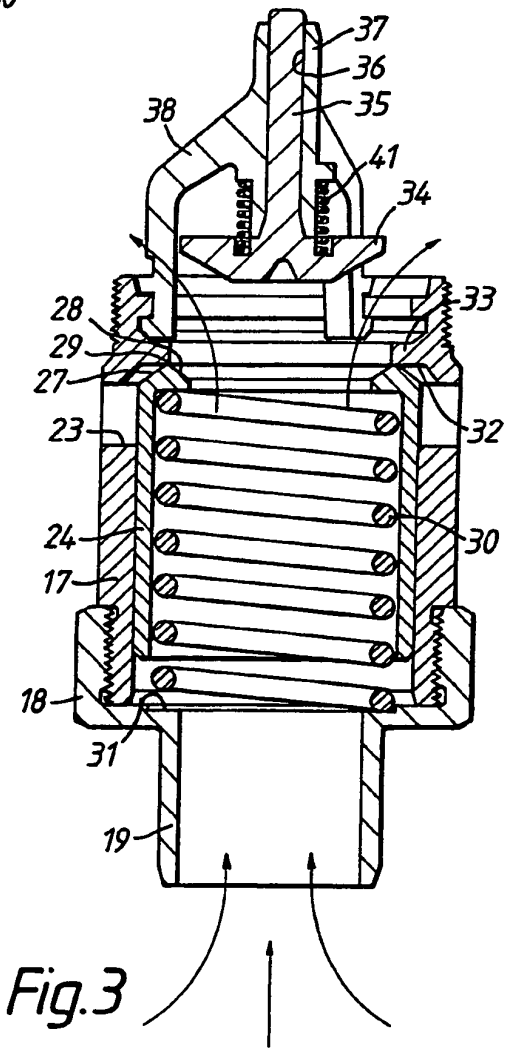
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Fig.3

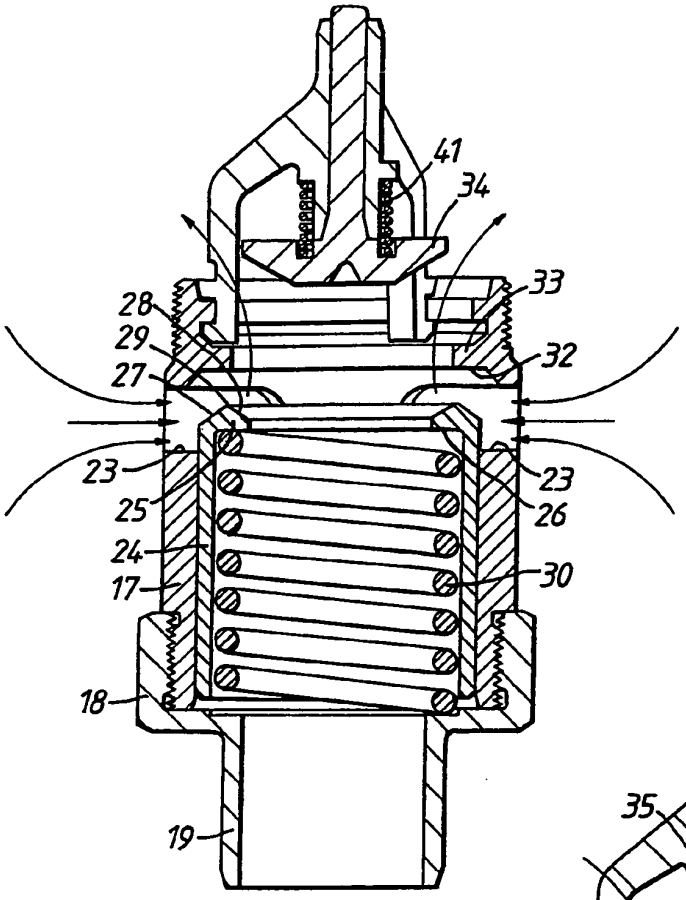
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Fig.4

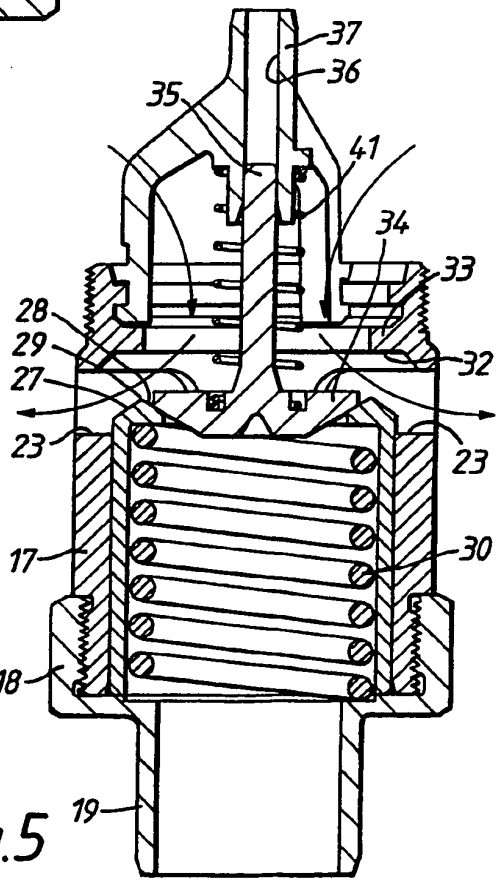
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Fig.5

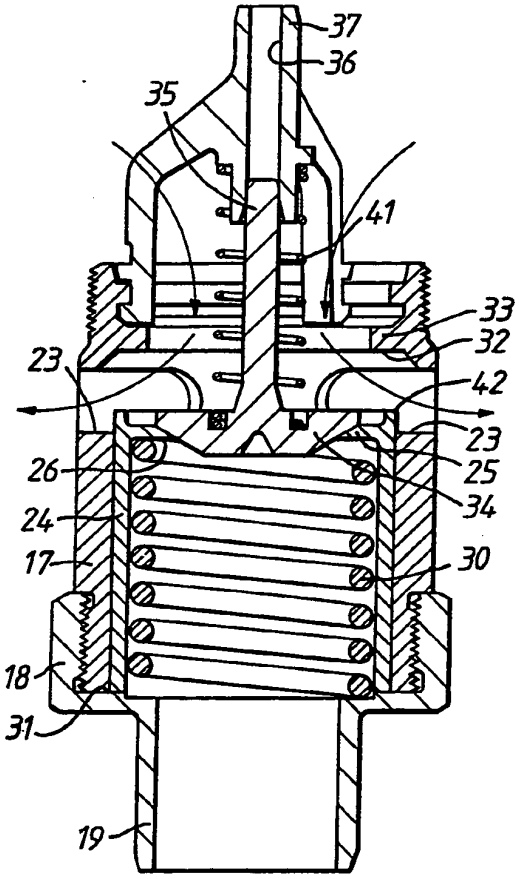

Fig.6

VALVES

The invention relates to valves and more particularly to valves for filter assemblies.

A commonly used form of filter assembly comprises a mounting having an inlet leading into a filter chamber and an outlet leading from the filter chamber. An elongate annular filter element is mounted within the chamber and has an exterior surface communicating with the inlet and an interior surface communicating with the outlet. Fluid supplied via the inlet passes from the exterior surface of the filter element to the interior surface from which the filtered fluid passes to the outlet.

Most filter elements are designed to have adequate strength to cope with flows and loads while the fluid flow is from the inlet to the outlet, but are not normally strong enough to withstand full flow force in the reverse direction (i.e. from the outlet to the inlet). In most fluid flow applications, this is not a problem, since the flow is normally only between the inlet and the outlet. However, in some applications, fluid flow may reverse and it is thus necessary to protect the filter element against the imposed loads of such a flow regime.

According to a first aspect of the invention, there is provided a reverse flow valve comprising a housing having an inlet and an outlet spaced from said inlet for the flow of fluid therethrough from said inlet to said outlet, a passage provided at a position in the housing between the inlet and the outlet, a member movable in the housing between a closed position in which said member prevents communication between said passage and said inlet and said outlet and an open position, and an actuating member which, when said fluid reverses the direction of flow thereof, causes said inlet to close and moves the member to said open position so that fluid entering said outlet passes to said passage.

Filter elements may also require protection against excessive differential pressures which would otherwise cause them to sustain damage and detract from their integrity of performance. High differential pressures can be caused, for example, at start up when the system is cold and the fluid viscosity is high because normal running temperatures have never been reached. This is a particular problem in outside mobile equipment in winter time in northern climates where large changes in viscosity can be experienced due to temperature extremes.

Secondly, high differential pressures can be caused as the

element progressively blocks up with dirt and contamination.

According to a preferred feature of the invention, the member is movable to said open position independently of said actuating member, when the differential pressure between said inlet and said outlet rises above a predetermined maximum, said passage receiving fluid flowing to said inlet and, when said member is in said open position, passing fluid to said outlet without said fluid passing said inlet.

The invention also includes within its scope a filter assembly comprising a mounting having an inlet leading to a filter chamber and an outlet leading from said filter chamber, an annular filter element within said chamber and having an exterior surface communicating with said mounting inlet and an interior surface communicating with the inlet of a reverse flow valve according to the first aspect of the invention, the outlet of said valve communicating with said mounting outlet and the valve passage communicating with said mounting inlet.

The following is a more detailed description of an embodiment of the invention, by way of xample, reference being made to the accompanying drawings in which:-

Figure 1 is a cross section through a part of a filter assembly showing a mounting inlet and a mounting outlet and a portion of a filter chamber and also showing a reverse flow valve connected between a filter element of the assembly and the outlet,

Figure 2 is a similar sectional view to Figure 1 of the valve of Figure 1, showing the valve in an operative position,

Figure 3 is a similar view to Figure 2 but showing the position of the valve during normal flow between the mounting inlet and the mounting outlet,

Figure 4 is a similar view to Figures 2 and 3 but showing the valve in a disposition adopted when the pressure differential between the mounting inlet and the mounting outlet exceeds a predetermined maximum,

Figure 5 is a similar view to Figures 2 to 4, but showing the disposition of the valve during reverse flow, and

Figure 6 is a similar view to Figures 2 to 5, but showing a modified form of a sleeve of the valve and showing the disposition of the modified valve during reverse flow.

The filter assembly comprises a casing indicated generally at 10 and including a body 11 provided with an inlet port 12 and an outlet port 13. A cylindrical filter chamber 14 depends from the body 11 and is closed at its lower end (not shown). The filter chamber 14 is, at its upper end, in screw threaded engagement with the body 11.

An elongate annular filter element 15 contained within the filter chamber 14.

A reverse flow valve indicated generally at 16 is interposed between the filter element 15, the inlet port 12 and the outlet port 13. The valve 16 comprises a cylindrical housing 17 open at both ends. An adaptor 18 is in threaded engagement with a lower end of the housing 17 and includes a spigot 19 which projects into an open end 20 of the filter element 15.

An upper end of the housing 17 is provided with a thread 21 which engages with a cooperating thread extending around an annular aperture 22 located between the inlet port 12 and the outlet port 13 and co-axial with the axis of the filter chamber 14.

As best seen in Figures 2 to 6, the housing 17 is provided intermediate its ends with passages 23 that extend

radially through the housing 17.

An annular sleeve 24 is a sliding fit inside the housing 17. An upper end of the sleeve 24 is provided with an inwardly directed annular flange 25 which has a radially extending lower surface 26 and an upper surface formed by outer and inner oppositely directed frustoconical surfaces 27 and 28 which meet at an annular ridge 29.

A coil spring 30 extends between a radial face 31 of the adaptor 18 and the lower surface 26 of the flange 25 and urges the ridge 29 against a radial face 32 of an annular flange 33 extending around the interior of the housing 17 adjacent the upper end of the housing 17. In this position, the exterior surface of the sleeve 24 covers the passages 23 and prevents access between the passages 23 and the interior of the housing 17.

A circular plate-like disc 34 is located above the upper end of the housing 17 and has a rod 35 extending coaxially with the disc 34 from a side of the disc 34 opposite the housing 17. The rod 35 is received for sliding movement in a bore 36 formed in a boss 37 co-axially with the axis of the filter chamber 14 and having three equiangularly spaced arms 38 projecting from the boss and provided at their ends remote from the boss with the respective slots

39 that are a snap fit with a rib 40 extending around the interior surface of the upper end of the housing 17. In this way, the disc 34 is removably mounted on the housing 17.

A coil spring 41 extends between the boss 37 and the disc 34 and urges the disc 34 into the position shown in Figure 2, which is the position of the valve when not acted on by any fluid.

As will be seen in Figure 2, in this position, the coil spring 41 urges the disc 34 downwardly so that its periphery contacts the inner frustoconical surface 28 on the sleeve 24. The force of the coil spring 41 is, however, comparatively weak and does not move the ridge 29 out of contact with the face 31.

In normal use, a fluid such as oil enters the inlet port 12 and passes to the exterior surface of the filter element 15. With the valve 16 in the position shown in Figure 2, the sleeve 24 closes the passages 23 and so there is no access into the interior of the housing 17 from the inlet port 12 through the passages 23. The fluid is filtered by the filter element 15 and passes into the interior of the filter element 15. From there, the filtered fluid passes through the spigot 19 which thus

acts as an inlet to the housing 17 and passes up through the sleeve 24 in the housing to the disc 34.

The force applied by the coil spring 41 is not sufficient to hold the disc 34 in contact with the inner frusto conical surface 28 and so the disc 34 lifts to open the end of the housing 17 and allow fluid to flow past the arms 38 to the outlet port 13. In this configuration, the valve 16 is as shown in Figures 1 and 3.

The force applied by the spring 30 to the sleeve 24 and the area of the outer frustoconical surface 27 is such that, under normal flow conditions, fluid passing through the passages 23 and acting on the outer frustoconical surface 27 produces an axial force that is insufficient to overcome the bias from the coil spring 30. At start-up when the system is cold and the fluid viscosity is high because normal running temperatures have not been reached or when the element is blocking up with dirt, the pressure differential across the valve 16 may increase above a predetermined normal level. When this occurs, the fluid force on the outer frustoconical surface 27 is sufficient to move the sleeve 24 axially downwardly against the force of the coil spring 30. This has the effect of allowing communication between the passages 23 and the outlet port 13. This is the configuration shown in Figure 4.

This has the effect of by-passing some of the fluid flow direct from the inlet port 12 to the outlet port 13 without passing through the filter element 15. The degree of by-pass will depend upon the pressure difference and will increase as the pressure difference increases, so providing automatic relief.

Referring now to Figure 5, if the flow of fluid is reversed so that fluid enters the outlet port 13, the force of the fluid and the action of the coil spring 41 move the disc 34 downwardly until the periphery of disc 34 engages the inner frustoconical surface 28 on the sleeve 24. The force is sufficient to move the sleeve 24 against the force of the coil spring 30 so sliding the sleeve 24 downwardly until the end of the sleeve 24 engages the adaptor 18.

In this disposition, the engagement of the disc 34 with the sleeve 24 prevents the passage of fluid through the sleeve 24 and down into the interior of the filter element 15. The opening of the passages 23 allows fluid to pass from the outlet port 13 direct to the inlet port 12 without passing through the filter element 15. Thus, the filter element 15 is protected.

There may be instances where prot ction against excessive

differential pressures is not required. In this case, the sleeve may be modified as shown in Figure 6. In this Figure, parts common to Figures 6 and to Figures 1 to 5 are given the same reference numerals and will not be described in detail.

In this modification, the outer frusto conical surface 27 is no longer present. Instead, the upper end of the sleeve 24 is provided with an annular radially extending surface 42 which normally seats against the face 32 on the flange 33 of the housing 17. During reverse flow, the modified valve operates as described above with reference to Figure 5. On normal flow, it operates as described above with reference to Figures 1 to 3. However, it is designed for circumstances where no excess pressure differential is encountered and so the sleeve 24 does not move independently.

It will be appreciated, that by unsnapping the arms 38 from the rib 40 the disc 34 and its associated parts can be removed. The housing 17 and the sleeve 24 can then be used to relieve differential pressure as described above with reference to Figure 3.

It will be appreciated that the valve 16 need not be arranged as described above. In essence, the arrangement

is formed by two valves - a first valve which controls direct communication between the inlet port 12 and the outlet port 13 (via the passages 23) and a second valve which opens and closes the inlet of the valve (the spigot 19) and also controls the position of the first valve to open and close the bypass passage. Any suitable arrangement that achieves these connections can be used.

CLAIMS

1. A reverse flow valve comprising a housing having an inlet and an outlet spaced from said inlet for the flow of fluid therethrough from said inlet to said outlet, a passage provided at a position in the housing between the inlet and the outlet, a member movable in the housing between a closed position in which said member prevents communication between said passage and said inlet and said outlet and an open position and an actuating member which, when said fluid reverses the direction of flow thereof, causes said inlet to close and moves the member to said open position in which fluid entering said outlet passes to said passage.

2. A valve according to claim 1, wherein said actuating member comprises a disc movable by said reverse flow from an inoperative position to an operative position in which said disc engages said member to move said member to said open position.

3. A valve according to claim 2, wherein the disc is spring biased into a position in which said disc engages said member without moving said member from said closed position, said reverse flow causing said movement and flow from said inlet to said outlet moving the disc to said

inoperative position against said spring bias.

4. A valve according to claim 3, wherein said disc has a rod projecting from one side thereof co-axially therewith, the rod being slidable in a bore to guide the disc in said movement.

5. A valve according to claim 4, wherein a coil spring extends around said rod between the sleeve and the disc to provide said spring bias.

6. A valve according to claim 4 or claim 5 wherein said sleeve is connected to said housing by a plurality of arms angularly spaced around the sleeve, the sleeve being located in said housing outlet.

7. A valve according to any one of claims 1 to 6 wherein said actuating member is removably engaged with said housing.

8. A valve according to claim 6 and claim 7 wherein the arms are a disengagable snap fit with said housing.

9. A valve according to any one of claims 1 to 8, wherein the member comprises a sleeve slidable in a bore in said housing extending between said inlet and said outlet, said

passage extending radially from said bore and being covered by said sleeve in said closed position of the sleeve.

10. A valve according to claim 9, wherein the sleeve is spring biased into said closed position.

11. A valve according to claim 10, wherein a coil spring is provided between said sleeve and said housing to provide said spring bias.

12. A valve according to any one of claims 9 to 11, wherein said housing includes a step which limits the movement of said sleeve under said spring bias.

13. A valve according to any one of claims 9 to 12 wherein said sleeve has an opening adjacent said housing outlet, the opening being closed by said operating member when reverse flow occurs.

14. A valve according to any one of claims 1 to 13, wherein the member is movable to said open position independently of said actuating member, when the differential pressure between said inlet and said outlet rises above a predetermined maximum, said passage receiving fluid flowing to said inlet and when said member

is in said open position, passing fluid to said outlet without said fluid passing said inlet.

15. A valve according to claim 14 and in which the member is spring biased into said closed position, the member including a surface acted on by fluid passing to said inlet to generate a force acting in a direction opposite to the spring biasing force, the surface and the spring bias being such that the fluid-generated force moves the member away from the closed position as the differential pressure rises above said predetermined maximum.

16. A valve according to claim 15, wherein said surface receives said fluid via said passage when said member is in said closed position.

17. A valve according to claim 15 and claim 9 wherein said surface is an annular surface extending around said sleeve and communicating with said radially extending passage.

18. A reverse flow valve substantially as hereinbefore described with reference to the accompanying drawings.

19. A valve for a filter assembly comprising a housing having an inlet, and an outlet spaced from said inlet for

the flow of fluid therethrough, and a bypass passage between said inlet and said outlet, a first valve held in an open position by a flow of fluid between said inlet and said outlet, a flow of fluid from said outlet to said inlet moving said first valve to close the inlet and open the bypass passage, a second valve being provided which, with fluid flow between the inlet and the outlet, opens the bypass passage when the pressure differential between the inlet and the outlet falls exceeds a predetermined maximum.

21. A valve according to claim 19, wherein said second valve is biased into a position in which said valve closes said bypass passage, movement of said first valve to close the inlet moving the second valve against said bias to open the bypass passage.

22. A valve according to claim 21, wherein the housing includes a bore and the second valve comprises a sleeve slidable in said bore, the bypass passage extending radially through said bore and being normally closed by said sleeve, with fluid passing through said sleeve from the inlet to the outlet, movement of said first valve closing said sleeve to prevent passage of fluid from said inlet to said outlet and moving said sleeve to communicate said outlet and said bypass passage.

23. A valve according to claim 19 wherein said first valve comprises a circular plate mounted for movement in a direction co-axial with the axis thereof, the plate being spring biased into a position in which the plate closes said sleeve without moving said sleeve to open said bypass passage.

24. A filter assembly comprising a mounting having an inlet leading into a filter chamber and an outlet leading from said filter chamber an annular filter element within said chamber and having an exterior surface communicating with said mounting inlet and an interior surface communicating with the inlet of a reverse flow valve according to any one of claims 1 to 18, the outlet to said valve communicating with said mounting outlet and the valve passage communicating with said mounting inlet.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report) 18

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Relevant Technical fields

(i) UK Cl (Edition L) F2V (VA6, VA26, VV3)

(ii) Int Cl (Edition 5) F16K (17/18); B01D (17/10, 35/147, 35/153)

Search Examiner
J P STEVENS

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
7 SEPTEMBER 1993

Documents considered relevant following a search in respect of claims 1-18 AND 24

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2069052 A (NISSAN) see Figures 2A-2E	
A	GB 0953755 (ATLAS COPCO) see Figure	

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Category	Identity of document and relevant passages	Relevant to claim(s)

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Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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